Queue # Q72 – Mansfield-South Troy 115 kV
Generation Interconnection

Network Impacts
The **#Q72 was studied as an injection of 110 MW (22 MW capacity) tapped into the Mansfield – South Troy 115kV line.** Project #Q72 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. Potential network impacts were as follows:

Generator Deliverability – at the 22 MW capacity value level
No problems identified.

New System Reinforcements

Multiple Facility Contingency – Reliability Requirements at the 110 MW full output level
NOTE: For Feasibility Studies, only double circuit (tower) outages are evaluated – not line fault and stuck breaker.
No problems identified.

Contribution to Previously Identified Overloads

1. The South Troy-E. Towanda 115 kV line is overloaded at around 184% of its emergency rating (119 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line **OR** for the **tower outage** of the Lackawanna-Mountain 230 kV and Lackawanna-Stanton 20 kV line. The Q72 project contributes approximately 75 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P47 and Q24 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   South Troy Substation:
   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

   Reconductor/upgrade of approximately 19.54 miles of transmission line between South Troy and Towanda (estimated to cost approximately $5,000,000)

   Towanda Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**

- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

2. The Q72 Tap-South Troy 115 kV line is overloaded at around 202% of its emergency rating (119 MVA) for the **tower outage** of the Lackawanna-Mountain 230 kV line and the Lackawanna-Stanton 230 kV line. The Q72 project contributes approximately 80 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O59, P47 and Q24 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   South Troy Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

   Reconductor/upgrade of approximately 8.73 miles of transmission line between South Troy and Q72 (estimated to cost approximately $2,650,000)

3. The Homer City-Shelocta 230 kV line is overloaded at around 128% of its emergency rating (854 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q72 project contributes approximately 24 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O56, O72, P22, P28, P45A, P47, P48, P60, Q04, Q34, Q36, Q53, Q56 and Q62 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Homer City Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a circuit breaker (estimated to cost approximately $425,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

   Reconductor/upgrade of approximately 10.73 miles of transmission line between Homer City and Shelocta (estimated to cost approximately $5,400,000)

   Shelocta Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

4. The Keystone 500/230 kV #3 transformer is overloaded at around 122% of its emergency rating (471 MVA) for the **tower outage** of the Juniata-Lewistown 230 kV line and the Juniata-Dauphin 230 kV line. The Q72 project contributes approximately 14 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P22, P28, P45A, P47, P48, P60, Q04, Q34, Q36, Q53, Q56 and Q62 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Keystone Substation:
   - **Replacement/upgrade of the 500-230 kV transformer (estimated to cost approximately $5,500,000) and will take approximately 2 years to complete.**

5. The Shelocta-Keystone 230 kV line is overloaded at around 117% of its emergency rating (854 MVA) for the **tower outage** of the WR TID-TIDD 345 kV line and the TIDD-COLLIE 345 kV line. The Q72 project contributes approximately 26 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the P28, P45A, P47, P48, P60, Q04, Q24, Q34, Q36, Q53, Q56 and Q62 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Keystone Substation:
   - **Replacement/upgrade of CT circuit (estimated to cost approximately $140,000)**

   Reconductor/upgrade of approximately 2.26 miles of transmission line between Keystone and Shelocta (estimated to cost approximately $1,400,000)

6. The Juniata-Lewistown 230 kV line is overloaded at around 103% of its emergency rating (617 MVA) for the **tower outage** of Brighton-Doubs 500 kV line and the Brighton-Conastone 500 kV line. The Q72 project contributes approximately 11 MW to the **contingency** facility loading which was previously identified as a potential congestion issue for the energy portion of the O38, O72, P45A, P47, P48, P60, Q04 and Q62 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   Reconductor/upgrade of approximately 24.69 miles of the 25.74 miles of transmission line between Juniata and Lewistown (estimated to cost approximately $12,350,000)

Contribution to Previously Identified System Reinforcements

To be determined in the System Impact Study.

Short Circuit

Detailed studies will be performed during the System Impact Study and the results will be included in the System Impact Study Report.

Potential Congestion Issues

There are several wind generation plants proposed in the general area of the Q72 project, each with only 20% of their peak output level considered as a Capacity Resource, and the remaining 80% as energy only resource. If all of the wind generation plants are at their maximum out put level simultaneously, a significant number of the 115 kV and 230 kV facilities, and many underlying system facilities are likely to be overloaded, restricting operation to a lower output level.

PJM and FirstEnergy studied the delivery of the energy portion of this interconnection request. The following analysis has been performed to inform the Interconnection Customer (Queue Q72) of potential congestion issues (operational restrictions) that may occur and affect the Q72 project's ability to operate at full output for certain system conditions. **The upgrades listed below are not required reliability upgrades for the Queue Q72 interconnection.** Please note that the number of facilities identified below as requiring upgrades is quite extensive – with a number of these facilities requiring reconductoring/rebuilding of transmission lines. Some of the reconductoring/rebuilding projects can be done in a "short" time frame while others are quite extensive and will require a "long" time to complete. In general, the time necessary to design and rebuild an extensive facility upgrade will take approximately 2-3 years to complete. If the Q72 Interconnection Customer wants to pursue construction of any of these upgrades, a separate "Transmission Interconnection" request must be submitted and the upgrades must be performed as merchant transmission projects.

Category A – Transmission System Impacts (Facilities monitored and operated by PJM)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q72) at 100% energy output and Peak summer loading (80/20 load forecast).

Q72 Operational considerations: The facilities below (potentially overloaded) are monitored and operated by PJM. PJM rules and methods for readjusting pre-contingency (N-1) dispatch will be followed if this system condition occurs. This may or may not cause curtailment of Q72 generation to below its 100% energy output.

1. The Shelocta-Keystone 230 kV line loads to approximately 149% of its normal rating (694 MVA). The energy portion of Q72 contributes approximately 21 MW to this condition. The line loads to approximately 156% of its emergency rating (854 MVA) for the outage of the Erie West – Wayne 345kV line. The energy portion of Q72 contributes approximately 24 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P28, P45A, P47, P48, P60, Q04, Q24, Q34, Q36, Q53, Q56 and Q62 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

Keystone Substation:

- **Replacement/upgrade of CT circuit (estimated to cost approximately $140,000)**
- **Replacement/upgrade of CT circuit (estimated to cost approximately $140,000)**
- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**
- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
- **Replacement/upgrade of line/wave trap (estimated to cost approximately $140,000)**

Reconductor/upgrade of approximately 2.26 miles of transmission line between Keystone and Shelocta (estimated to cost approximately $1,150,000)

Shelocta Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $75,000)**
- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

2. The Homer City- Shelocta 230 kV line loads to approximately 141% of its normal rating (694 MVA). The energy portion of Q72 contributes approximately 18 MW to this condition. The line loads to approximately 151% of its emergency rating (854 MVA) for the outage of the Erie West – Wayne 345kV line. The energy portion of Q72 contributes approximately 20 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the O56, O72, P22, P28, P45A, P47, P48, P60, Q04, Q24,Q34, Q36, Q53, Q56 and Q62 projects.

To mitigate this overload condition would require replacement/upgrade of the following:

Homer City Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**
- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
- **Replacement/upgrade of a circuit breaker (estimated to cost approximately $425,000)**
- **Replacement/upgrade of a CT circuit (estimated to cost approximately $140,000)**

Reconductor/upgrade of approximately 10.73 miles of transmission line between Homer City and Shelocta (estimated to cost approximately $5,400,000)

Shelocta Substation:

- **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**

- **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

3. The Lewistown-Juniata 230 kV line loads to approximately 129% of its normal rating (499 MVA). The energy portion of Q72 contributes approximately 6 MW to this condition. The line loads to approximately 136% of its emergency rating (617 MVA) for the outage of the Keystone-Shelocta-Homer City 230kV line. The energy portion of Q72 contributes approximately 6 MW to this **normal** overload condition which was previously identified as a potential congestion issue for the energy portion of the O38, O72, P45A, P47, P48, P60 and Q04 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   <u>Juniata Substation:</u>
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $85,000)**

   Reconductor/upgrade of approximately 25.74 miles of transmission line between Juniata and Lewistown (estimated to cost approximately $12,900,000)

4. The Juniata – Junia-H1 230kV line loads to approximately 104% of its emergency rating (573 MVA) for the outage of the Dauphin – Juniata 230kV line. The energy portion of Q72 contributes approximately 4 MW to this **contingency** overload condition.

   NOT A PENELEC FACILITY. Detailed analysis of this facility will be included in the System Impact Study Report.

5. The Keystone 500/230kV transformer 4 loads to approximately 180% of its emergency rating (465 MVA) for the outage of the Keystone 500/230kV transformer 3. The energy portion of Q72 contributes approximately 17 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P22, P28, P45A, P47, P48, P60, Q04, Q36, Q53, Q56 and Q62 project.

   To mitigate this overload condition would require replacement/upgrade of the following:
   <u>Keystone Substation:</u>
   - **Replacement/upgrade of the 500-230 kV transformer (estimated to cost approximately $5,500,000) and will take approximately 2 years to complete.**

6. The Keystone 500/230kV transformer 3 loads to approximately 178% of its emergency rating (471MVA) for the outage of the Keystone 500/230kV transformer 4. The energy portion of Q72 contributes approximately 17 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P22, P28, P45A, P47, P48, P60, Q04, Q36, Q53, Q56 and Q62 project.

To mitigate this overload condition would require replacement/upgrade of the following:
Keystone Substation:
Replacement/upgrade of the 500-230 kV transformer (estimated to cost approximately $5,500,000) and will take approximately 2 years to complete.

7. The Lewistown-Shingletown 230kV line loads to approximately 112% of its emergency rating (505 MVA) for the outage of the Altoona-Raystown-Lewistown 230kV line. The energy portion of Q72 contributes approximately 10 MW to this **contingency** overload condition.

   To mitigate this overload condition would require replacement/upgrade of the following:
   Lewistown Substation:
   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $140,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $140,000)**

Category B – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec)

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q72) at 100% energy output and Peak summer loading (80/20 load forecast).

Q72 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q72 generation to below its 100% energy output.

8. The South Troy-Q72 Tap 115 kV line loads to approximately 203% of its emergency rating (119 MVA) for the outage of the K02 Tap – Moshannon 230kV line. The energy portion of Q72 contributes approximately 64 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the O59, P47 and Q24 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:

   South Troy Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

   Reconductor/upgrade of approximately 8.73 miles of transmission line between South Troy and Q72 (estimated to cost approximately $2,650,000)

9. The South Troy-E. Towanda 115 kV line loads to approximately 226% of its normal rating (94 MVA). The energy portion of Q72 contributes approximately 60 MW to this **contingency** overload condition which was previously identified as a potential congestion issue for the energy portion of the P47 and Q24 projects.

   To mitigate this overload condition would require replacement/upgrade of the following:
   South Troy Substation:
   - **Replacement/upgrade of line/wave trap (estimated to cost approximately $115,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**
   - **Replacement/upgrade of a CT circuit (estimated to cost approximately $100,000)**

   Reconductor/upgrade of approximately 19.54 miles of transmission line between South Troy and Towanda (estimated to cost approximately $5,000,000)

   Towanda Substation:
   - **Replacement/upgrade of a disconnect switch (estimated to cost approximately $80,000)**
   - **Replacement/upgrade of substation conductor (estimated to cost approximately $125,000)**

Category C – Underlying Transmission System Impacts (Facilities monitored and operated by Penelec). These contingency overloads were not possible prior to the Queue Q72 project. The identified contingency overloads are caused directly by Q72 and are likely to cause Q72 curtailment to less than 100% energy output during summer and possibly winter operation.

Load flow model used for analysis: Generator Deliverability dispatch with all generators (in-service or active Queue generators preceding Q72) at 100% energy output and Peak summer loading (80/20 load forecast).

Q72 Operational considerations: The facilities below (potentially overloaded) are not monitored and operated by PJM. Penelec monitors these facilities in real time and will readjust the system according to Penelec's rules and methods if this system condition occurs. This may or may not cause curtailment of Q72 generation to below its 100% energy output.

None.

